MLSR050C

500 mA, Compact, Single Output POL Switching Regulator

Key Features:

- 500mA Output Current
- Miniature DFN Package
- -40°C to +105°C Temp
- Short Circuit Protected
- Up to 90% Efficiency
- Industry Standard Pin-Out

Electrical Specifications

Specifications typical @ +25°C, nominal input voltage & rated output current, unless otherwise noted. Specifications subject to change without notice.

Input

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage	See Model Selection Guide on Page 2				VDC
Reverse Polarity at Input			Avoid / Not Protected		
Input Filter			Capacitance Filter		
CTRL (See Note 6)	Module On		CTRL pin open or pulled high (TTL 2.5~5VDC)		
	Module Off		CTRL pin pulled low to GRND (-Vo) (0.~0.6VDC)		
	Input current when off		240		uA

Output

Parameter	Conditions		Min.	Typ.	Max.	Units
Output Voltage Accuracy	Full Load	3.3V Output		±2	±4	%
		Other Outputs		±2	±3	
Line Regulation	Full Load, Input Voltage Range			±0.2		%
Load Regulation	Nominal Vin, 10-100% Load			±0.4		%
Ripple & Noise, See Note 1	20MHz Bandwidth, Full Load			20	45	mVp-p
Temperature Coefficient	-40°C to +105°C			±0.02		%/°C
Transient Response Deviation	Nominal Vin, 25% load step change			50	120	mV
Transient Recovery Time				0.2	0.8	ms
Output Short Circuit			Continuous, Self-Recovery			

General

Parameter	Conditions	Min.	Typ.	Max.	Units
Switching Frequency	Full Load, Nominal Input Voltage		2.0		MHz

Environmental

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range		-40		+105	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Storage Humidity	Non condensing	5		95	%RH
Moisture Sensitivity Level	IPC/JEDEC J-STD-020D.1		Level 3		
Pollution Degree			PD3		

Physical

Case Size	0.35 x 0.28 x 0.12 in (See mechanical diagrams on page 5)
Case Material	Black plastic; flame retardant and heat resistant (UL94V-0 rated)
Weight	0.020 oz (0.58g) (See mechanical diagrams on page 5)

EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions, See Page 3	CISPR32/EN 55032		B
Conducted Emissions	CISPR32/EN 55032		B

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL-HDBK-217F@25°C	9.152			MHours
Reflow Soldering Temperature	Peak temperature ≤245°C, duration ≤60s max. over 217°C				

CE

RoHS

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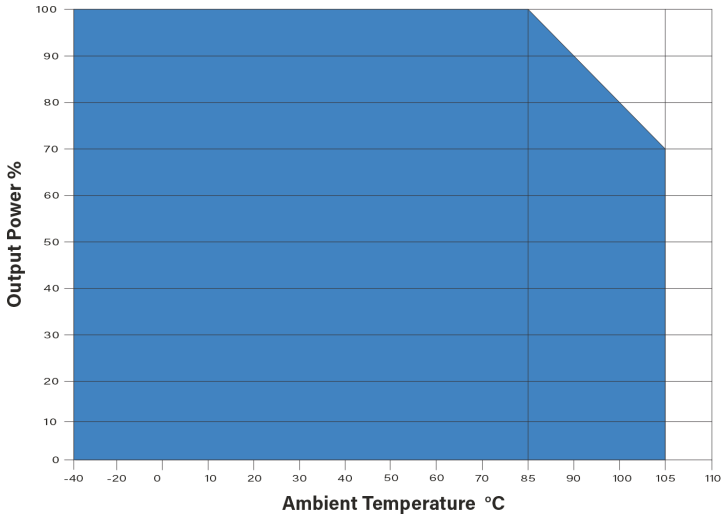
Model Selection Guide

Model Number	Input			Output		Full Load Efficiency (%, Typ)	Capacitive Load (µF, Max) (See Note 3)
	Voltage (VDC)		Current (mA)	Voltage (VDC)	Current (mA, Max)		
	Nominal	Range	No Load				
MLSR0524-033C	24	4.5 - 36	0.1	3.3	500	79	680
	12	7 - 32	0.1	-3.3	-300	82	470
MLSR0524-05C	24	6.5 - 36	0.1	5	500	83	680
	12	7 - 31	0.1	-5	-300	78	470
MLSR0524-065C	24	8 - 36	0.1	6.5	500	85	680
	12	7 - 28	0.1	-6.5	-250	79	470
MLSR0524-09C	24	12 - 36	0.1	9	500	90	680
	12	8 - 27	0.1	-9	-200	82	470
MLSR0524-12C	24	15 - 36	0.1	12	500	91	680
	12	8 - 24	0.1	-12	-150	83	470
MLSR0524-15C	24	18 - 36	0.1	15	500	91	680
	12	8 - 21	0.1	-15	-150	81	470

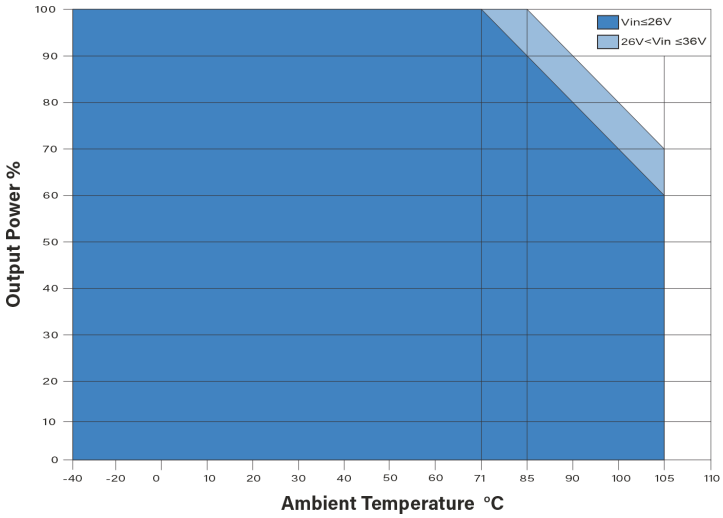
1. The "parallel cable" method is used for ripple & noise test.
2. If the product is not operated within the required load range, the product performance cannot be guaranteed to comply with all parameters in the datasheet.
3. The maximum capacitive load offered were tested at input voltage range and full load.
4. Unless otherwise specified, parameters in this datasheet were measured under the conditions of Ta=25°C, humidity < 75% with nominal input voltage and rated output load.
5. For input voltage exceeding 30VDC, an input capacitor of 22uF/50V is required.
6. The positive output CTRL pin voltage is referenced to input GRND. Negative output CTRL voltage is referenced to -Vo.

For Tape & Reel packaging, add the suffix "**-TR**" to the model number (i.e. **MLSR0524-05C-TR**). Details on Tape & Reel packaging are on page 6.

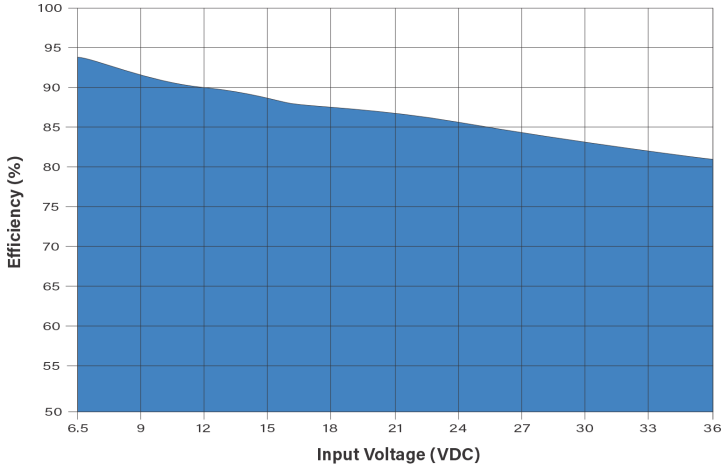
Temperature Derating: 3.3, 5, 6.5V Outputs



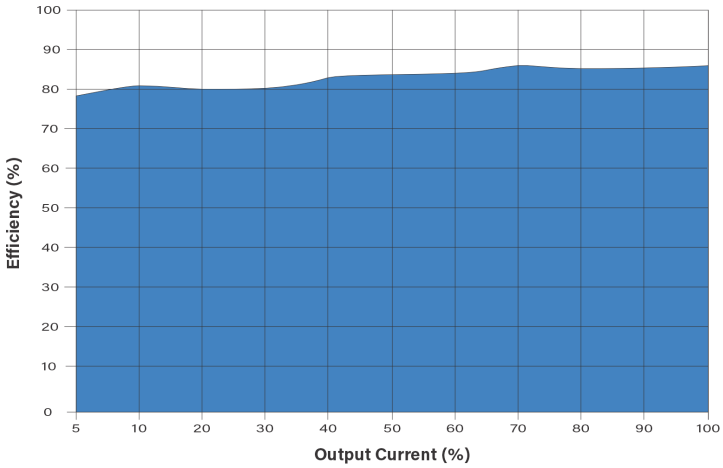
Temperature Derating: 9, 12, 15V Outputs



Efficiency vs Input Voltage (Full Load)



Efficiency vs Output Load (Vin=24V)



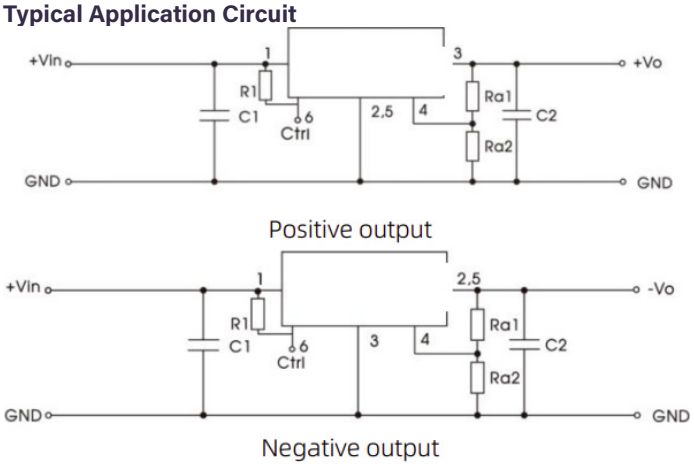
EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions (RE)	CISPR32/EN55032		B (Note 2)
Conducted Emissions (CE)	CISPR32/EN55032		B (Note 2)
ESD	IEC/EN61000-4-2	B	Contact ±6kV (Note 1)
RS	IEC/EN61000-4-3	A	10V/m
CS	IEC/EN61000-4-6	A	3V.r.m.s
EFT	IEC/EN61000-4-4	B	±1kV(Note 3)
Surge	IEC/EN61000-4-5	B	line to line ±1kV (Note 3)

Notes:
1. The static level of the CTRL and trim pin is ±2kV when they are not connected to external devices. It is suggested to connect an external capacitor (105k/50V) from CTRL to GND/-Vo to meet ESD (±6kV) of the CTRL pin, and to connect a varistor (22V/30A) from trim to GND/-Vo to meet ESD (±6kV) of the trim pin.
2. Use EMC Compliance Circuit (Part 2) to meet CISPR/EN55032 level B.
3. Use EMC Compliance Circuit (Part 1) to meet EN61000-4-4 and EN61000-4-5.

Application Circuits

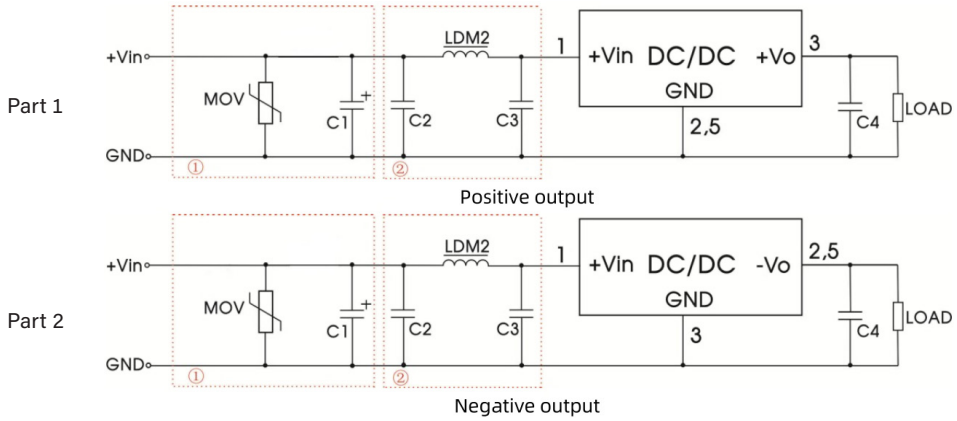
Typical Application Circuit



Model	C1 (Ceramic)	C2 (Ceramic)	Ra1/Ra2 (Trim)
MLSR0524-033C	10uF/50V	22uF/10V	100kΩ
MLSR0524-05C		22uF/10V	
MLSR0524-065C		22uF/16V	
MLSR0524-09C		22uF/16V	
MLSR0524-12C		22uF/25V	
MLSR0524-15C		22uF/25V	

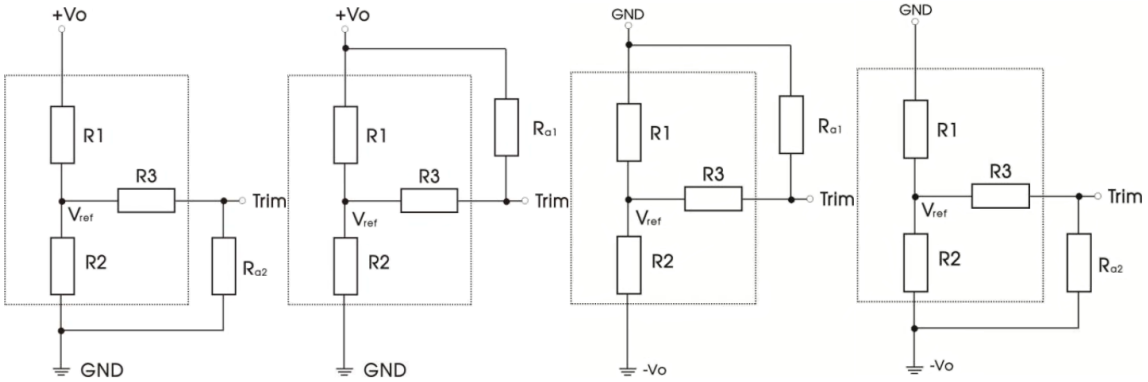
Notes:
1. The required C1 and C2 capacitors must be connected as close as possible to the terminals of the module.
2. Refer to the table for capacitor values. For certain applications, increased values and/or tantalum or low ESR electrolytic capaictors may also be used instead.
3. Converter cannot be used for hot swap and with output in parallel.
4. 100k is recommended for R1 when CTRL function is used. If the CTRL function is not needed, the CTRL pin can be shorted to the VIN pin without R1.

EMC Compliance Circuit



Model	MOV	LDM1	C1	C2	LDM2	C3	C4
MLSR0524-033C (Positive Output)	S20K30	82uH	680uF/50V	10uF/50V	10uH	0.47uF/50V	22uF/10V
MLSR0524-033C (Negative Output)					22uH	-	
MLSR0524-05C					10uH	-	
MLSR0524-065C/ MLSR0524-09C					10uH	1uF/50V	22uF/16V
MLSR0524-12C/ MLSR0524-15C					22uH	0.47uF/50V	22uF/25V

Trim Function for Output Voltage Adjustment (Open if Unused)



Positive output trim up | Positive output trim down | Negative output trim up | Negative output trim down

Notes:
1. Positive output application: connect trim resistor to GRND/Vo respectively for adjusting up/down.
2. Negative output application: connect trim resistor to GRND/Vo- respectively for adjusting up/down.

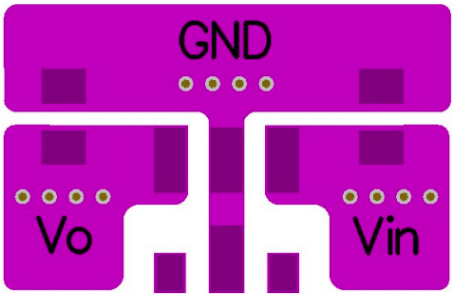
Trim up: $R_{a2}=\frac{aR_2}{R_2-a}-R_3,\quad a=R_2//(R_3+R_{a2})=\frac{V_{ref}}{V_o'\text{-}V_{ref}}R_1$

Trim down: $R_{a1}=\frac{aR_1}{R_1-a}-R_3,\quad a=R_1//(R_3+R_{a1})=\frac{V_o'\text{-}V_{ref}}{V_{ref}}R_2$

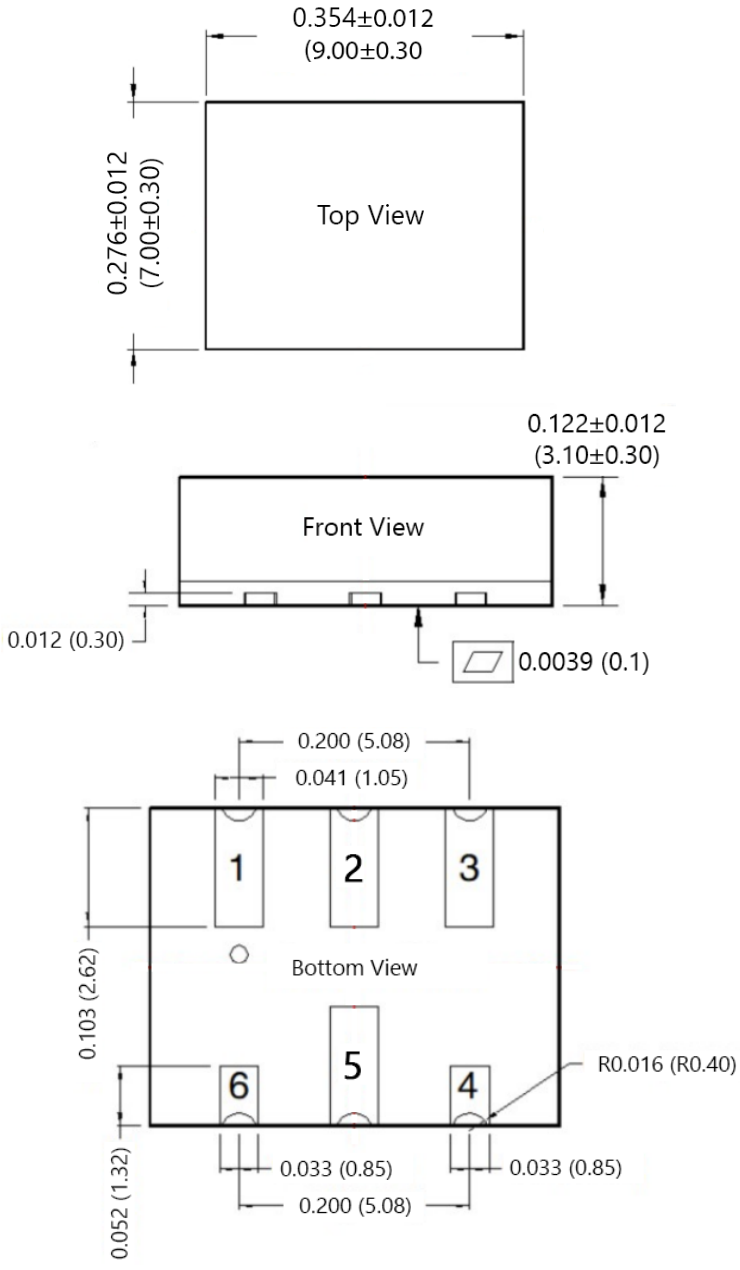
VOUT (V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	Vref (V)
3.3	47	15	82	0.8
5	36	6.875	36	0.8
6.5	47	6.598	36	0.8
9	75	7.318	47	0.8
12	120	8.571	51	0.8
15	100	5.634	36	0.8

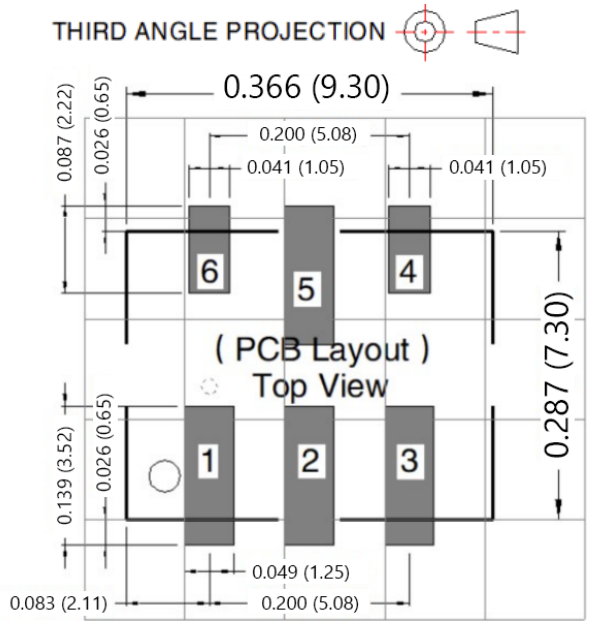
VOUT Nom.	±3.3VDC		±5VDC		±6.5VDC		±9VDC		±12VDC		±15VDC	
VOUT Trim	Ra1 (KΩ)	Ra2 (KΩ)	Ra1 (KΩ)	Ra2 (KΩ)	Ra1 (KΩ)	Ra2 (KΩ)	Ra1 (KΩ)	Ra2 (KΩ)	Ra1 (KΩ)	Ra2 (KΩ)	Ra1 (KΩ)	Ra2 (KΩ)
2.97	221	-	-	-	-	-	-	-	-	-	-	-
3.63	-	34	-	-	-	-	-	-	-	-	-	-
4.5	-	-	236	-	-	-	-	-	-	-	-	-
5.5	-	-	-	20	-	-	-	-	-	-	-	-
5.85	-	-	-	-	329	-	-	-	-	-	-	-
7.15	-	-	-	-	-	22	-	-	-	-	-	-
8.1	-	-	-	-	-	-	562	-	-	-	-	-
9.9	-	-	-	-	-	-	-	19	-	-	-	-
10.8	-	-	-	-	-	-	-	-	948	-	-	-
13.2	-	-	-	-	-	-	-	-	-	29	-	-
13.5	-	-	-	-	-	-	-	-	-	-	811	-
16.5	-	-	-	-	-	-	-	-	-	-	-	17

Temperature Rise Test PCB Layout



Mechanical Diagrams





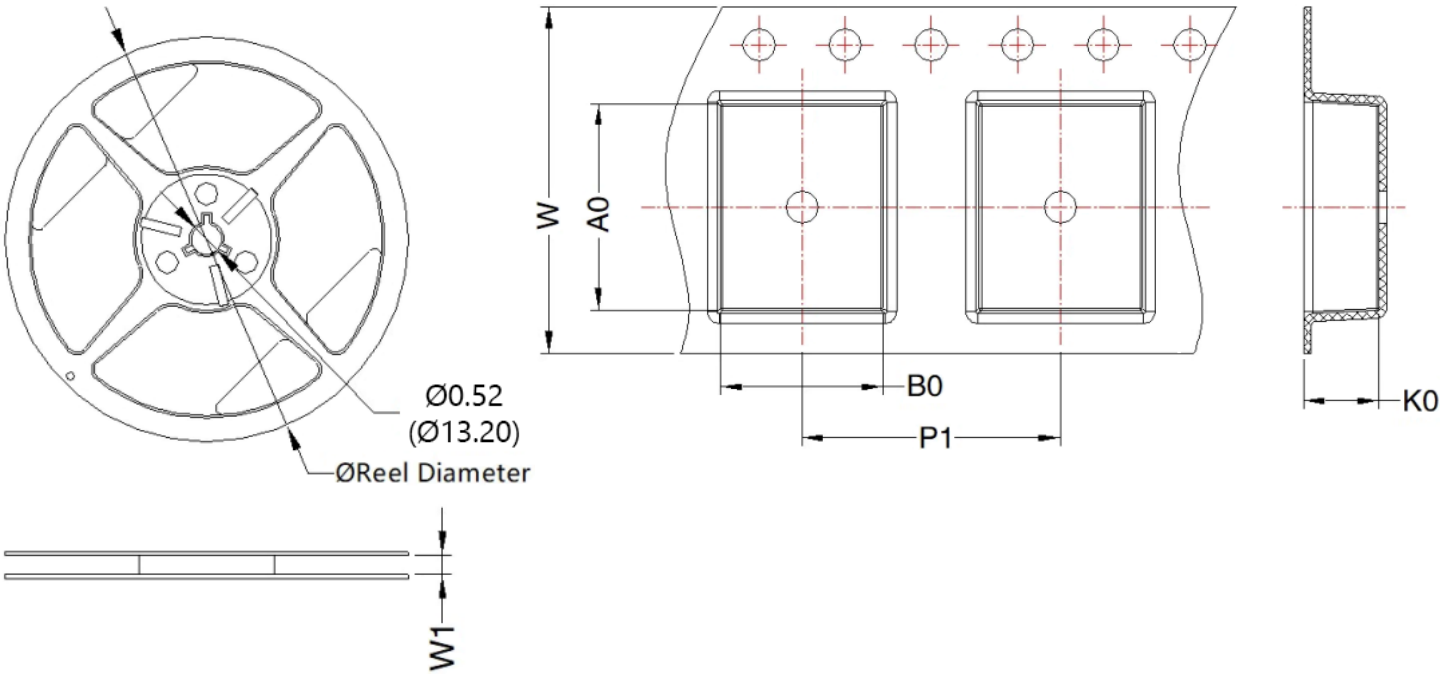
Note: Grid 2.54 x 2.54 mm

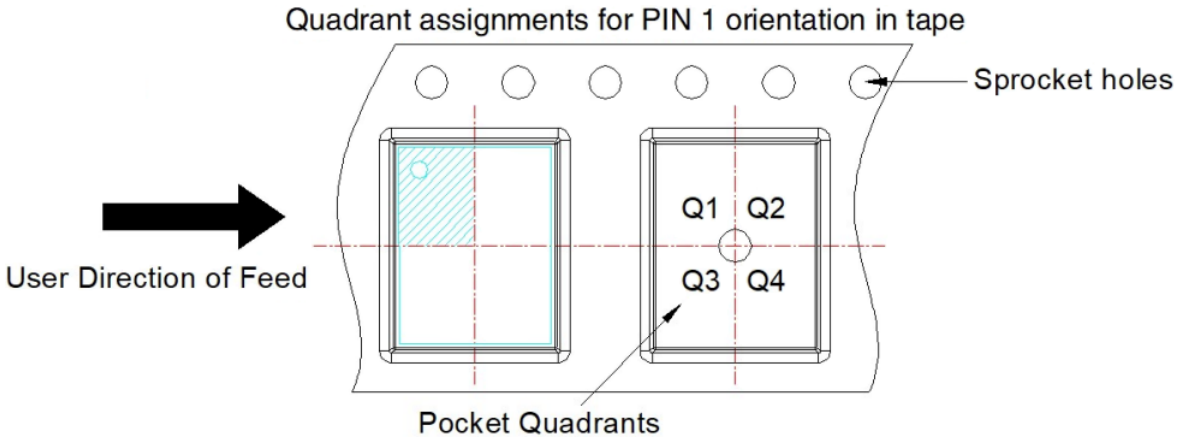
Pin	Positive Output	Negative Output
1	+Vin	+Vin
2	GND	-Vo
3	+Vo	GND
4	Trim	Trim
5	GND	-Vo
6	CTRL	CTRL

Notes:
- All dimensions are typical in inches (mm)
- General tolerances: ±0.004 (±0.10)

Weight:
- 0.020 oz (0.58g)

Tape & Reel Packaging





Package Type	Pin	MPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
DFN 7x9	7	400	180.0	16.4	9.56	7.56	3.5	12.0	16.0	Q1